



# S&T Newsletter



A Quarterly of the  
Centre for Science and Technology of the Non-Aligned  
and Other Developing Countries (NAM S&T Centre)

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## FROM THE DG'S DESK



Season's Greetings!!

The NAM S&T Centre successfully organised an International Roundtable on the 'Impacts of Extreme Natural Events: Science & Technology for Mitigation (IRENE)' at Colombo, Sri Lanka during 13-15 December 2017 jointly with the National Science & Technology Commission (NASTEC) and the Research Centre – Technology for Disaster Prevention, South Eastern University of Sri Lanka, which was attended by 44 senior professionals from 18 countries. A Colombo Resolution on 'Mitigation of Impacts of Human Hazards due to Extreme Natural Events: Five Year Road-Map on the Adoption and Development of Scientific & Technological Advancements' was adopted during the event.

The Centre sponsored a 7-member delegation of professionals from its member countries to attend the 3<sup>rd</sup> Science Forum South Africa (SFSA) organised by the Department of Science & Technology, South Africa in Pretoria on 7-8 December 2017 on the theme: 'Igniting Conversations about Science' with the key objective to create a platform for a vibrant debate on the role of STI in society. 2,700 intellectuals from 60 countries and a number of multilateral organisations exchanged ideas on interfacing STI in building a better society and showcased the latest science innovations. During SFSA-2017 I was honoured by the S&T Minister of South Africa by conferring on me the Science Diplomacy Award for International Peace, Understanding and Solidarity.

The Centre has published its latest book – 75<sup>th</sup> which is titled 'Science, Technology and Innovation Policies and Strategies Development in Developing Countries' edited by Prof. Zakaria Fouad Fawaz Hassan Abdalla (Egypt).

The Centre announces the organisation of an International Workshop on 'Technological Innovation and Management for Sustainable Development (For Greener, Safer & Smarter World)' in Gwalior, India during 27-29 March 2018.

Happy Reading!

  
(Arun P. Kulshreshtha)

## Centre Organised

International Roundtable on

The Impact of Extreme Natural Events: Science & Technology for Mitigation (IRENE)

Colombo, Sri Lanka, 13-15 December 2017

The global change in climate is leading to the alterations in frequency, intensity, spatial extent and duration of weather and climate extremes. These climate extremes impact severely on both human and ecosystems including economic losses, sectors such as tourism and agriculture, urban settlements, small island states, etc. Global demographic trends suggest that more people are living in areas vulnerable to the sudden onset of natural disasters even as scientists predict that the frequency and



Inauguration of International Roundtable – IRENE -,  
Colombo, Sri Lanka, 13-15 December 2017

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## Centre Sponsors

Science Forum South Africa:  
Igniting Conversations about Science

Pretoria, South Africa, 7-8 December 2017

The NAM S&T Centre participated in the third 'Science Forum South Africa (SFSA)' which was organised in Pretoria on 7-8 December 2017 on a theme on 'Igniting Conversations about Science'. The key objectives of the SFSA 2017, successfully held for the third time after the Forum Conference held in Pretoria in December 2015 and 2016, were to create a platform for a vibrant debate on the role of science, technology and innovation (STI) in society; promote international STI partnerships; and establish a platform for key STI innovation actors, including senior government leaders, academics, scientists, industry, civil society, and students to interact. The Forum deliberations were focussed on having pioneering ideas concerning the global, and more specifically, Africa's, strategy for STI to meet different dimensions of the challenges faced in the developing world.



Science Forum South Africa (SFSA),  
Pretoria, 7-8 December 2017 –  
Science Diplomacy Award to Prof.  
Arun P. Kulshreshtha By S&T Minister  
of South Africa

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Inaugural Group Photograph of International Roundtable on Impacts of Extreme Natural Events: Science & Technology for Mitigation (IRENE), Colombo, Sri Lanka, 2017

intensity of these disasters are likely to increase as a result of the effects of climate change. This state of affairs requires nothing short of a technological revolution to address extreme natural patterns like floods, earthquakes, mudslide, torrential rain, hurricanes, tornadoes etc. Actions at multiple levels engaging different actors viz., national and international stakeholders and private institutions is the need of the hour to push the international protection regime forward.

The emerging trends in extreme natural phenomena coupled with recent high-profile mega-disasters like Monsoon flooding in Bangladesh; Hurricane Irma in USA and Caribbean; floods in different regions of India; mudslide in Colombia; and earthquakes in Mexico and Iran, are raising global awareness of the need to build the capacity of national governments, civil society organisations and international entities to prevent, respond to and recover from natural disasters. Keeping this in view, the NAM S&T Centre in partnership with the National Science & Technology Commission (NASTEC), Sri Lanka and the Research Centre-Technology for Disaster Prevention, South Eastern University of Sri Lanka (RC-TDP, SEUSL) organised an International Roundtable on 'Impacts of Extreme Natural Events: Science & Technology for Mitigation (IRENE)' in Colombo, Sri Lanka during 13-15 December 2017, which brought the scientists, experts and professionals engaged in R&D, policy making and implementation, social activists and other stake holders to a common forum for sharing views and experiences for the development of a road map for reducing the risks in real situations.

The Inaugural Session started with the National Anthem and lighting of the traditional lamp. During the Inaugural Session Prof. Dr. M. J. S. Wijeyaratne, Chairman, National Science & Technology Commission (NASTEC) made a welcome address, which was followed by the address of Prof. Dr. Arun P. Kulshreshtha, Director General, Centre for Science & Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre), who presented the genesis of the event and also briefly described the activities of the inter-governmental organisation headed by him. The Chief Guest, Mr. Udaya R. Seneviratne, Secretary, Ministry of Science, Technology & Research (MOSTR), Sri Lanka and Vice President, NAM S&T Centre in his Inaugural Address remarked about the calamities being faced by the humanity due to climate change related natural disasters. Prof. Dr. M.M.M. Najim, Vice Chancellor, South Eastern University of Sri Lanka (SEUSL) gave an introduction with the background of the Roundtable; and a Vote of Thanks was delivered by Dr. Muditha Liyanagedera, Director and CEO, NASTEC.

The Roundtable was attended by 44 senior professionals from 18 countries –Egypt, India, Indonesia, Iran, Iraq, Malaysia, Mauritius, Myanmar, Nepal, Pakistan, Palestine, Qatar, South Africa, Togo, The United Kingdom, Vietnam and Zambia, and the host country Sri Lanka. The 27 foreign participants were from Egypt [Prof. Dr. Salah M. Mahmoud, Professor, Geodynamics, National Research Institute of Astronomy and Geophysics (NRIAG), Cairo]; India [Dr.

B. C. Prabhakar, Professor, Department of Geology & Director, IQAC, Bangalore University, Bangalore; Dr. Bikasha Chandra Panda, Professor, Civil Engineering, Indira Gandhi Institute of Technology, Dhenkanal, Odisha; Dr. Debi Prasanna Kanungo, Senior Principal Scientist & Professor, Geotechnical Engineering Division, CSIR-Central Building Research Institute, Roorkee, Uttarakhand; Dr. K. N. Radhika, Associate Professor, Department of Civil Engineering, East West Institute of Technology, Bangalore; Dr. Krushna Chandra Gouda, Senior Scientist and Faculty, CSIR Fourth Paradigm Institute (C-MMACS), Bangalore; Prof. Ravindra Arora, Professor (Retd.), Department of Electrical Engineering, Indian Institute of Technology, Kanpur; and Prof. V. Madha Suresh, Professor and Head, Centre for Natural Hazards and Disaster Studies, School of Earth and Atmospheric Sciences, University of Madras]; Indonesia [Dr. Finarya Legoh, Principal Engineer, The Agency for Assessment & Application of Technology (BPPT), Jakarta]; Iran [Dr. Ali Reza Nejadmohammad Namaghi, Head of the Department, Department of Natural Resources, Khorasan-e-Razavi Agricultural and Natural Resources Research and Education Center, Mashhad; and Prof. M. Kafi, Professor and President, Ferdowsi University of Mashhad (FUM), Mashhad]; Iraq [Mrs. Noor Adnan Jasim, Geologist, Remote Sensing Center, Space and Communications Directorate, Ministry of Science and Technology, Baghdad]; Malaysia [Prof. Dr. Biswajeet Pradhan, Professor, Department of Civil Engineering, University Putra Malaysia, Serdang; and Prof. Dr. Chandima Gomes, Professor, Department of Electrical and Electronics Engineering, Universiti Putra Malaysia, Selangor; and Mrs. Nik Noorhayati Nik Abdul Majid, Meteorological Officer, National Climate Centre, Malaysian Meteorological Department, Selangor]; Mauritius [Mr. Damonsing Jerry Robin, Senior Civil Engineer, Ministry of Public Infrastructure and Land Transport, Port Louis]; Myanmar [Dr. Myat Soe Aung, Deputy Director, Department of Research and Innovation, Ministry of Education, Yangon]; Nepal [Prof. Dr. Jiba Raj Pokharel, Vice-



Group Photo of Participants of International Roundtable –IRENE – sponsored by NAM S&T Centre

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Chancellor, Nepal Academy of Science and Technology (NAST), Lalitpur]; Pakistan [Dr. Muhammad Imran Shahzad, Assistant Professor / Associate Head of Department, COMSATS Institute of Information Technology (CIIT), Islamabad]; Palestine [Mr. Imadoddin Al-Baba, Director, Department of Scientific Research, Environment Quality Authority, Al-Bireh]; Qatar [Dr. Muhammad Imran, Scientist, Qatar Computing Research Institute (QCRI), Doha]; South Africa [Dr. Raymond John Durrheim, South African Research Chair in Exploration, Earthquake & Mining Seismology, University of the Witwatersrand, Johannesburg]; Togo [Dr. Komi Kossi, Research Associate, WASCAL, University of Lomé, Lomé]; United Kingdom [Dr. Kaushal Keraminiyage, Department Lead for Teaching and Learning, Department of Architecture and 3D Design Global Disaster Resilience Research Centre; and Dr. Nuwan Dias, Post Doctoral Researcher, School of Art, Design & Architecture, University of Huddersfield]; Vietnam [Dr. Bach Tan Sinh, Acting Director, Research Centre of S&T Policy, National Institute for S&T Policy and Strategy Studies (NISTPASS), Hanoi]; and Zambia [Mr. Lusekelo Kasunga, National Remote Sensing Centre (NRC), Lusaka]. The NAM S&T Centre was represented by its Director General, Prof. Arun P. Kulshreshtha and Ms. Rashmi Srivastava, Research Associate.

The Sri Lankan participants, who made technical presentations during the Roundtable, were Mr. A. Narmilan, Lecturer (Prob.), Department of Biosystems Technology, Faculty of Technology, South Eastern University of Sri Lanka (SEUSL); Ms. E. Pavithira, Demonstrator, Department of Biosystems Technology, SEUSL; Mr. G. Naveendrakumar, Postgraduate Student, Postgraduate Institute of Science (PGIS), University of Peradeniya; Dr. H.K.W.I. Jayawardena, Senior Lecturer in Physics, The Open University of Sri Lanka; Mr. K. Nijamir, Assistant Lecturer, Department of Geography, SEUSL; Dr. Lareef Zubair, Principal Scientist & Scientific Writer, Foundation for Environment Climate and Technology; Mr. S. Mathanraj, Lecturer (Prob.), Department of Geography, Eastern University of Sri Lanka, Chenkaladi; Dr. M. G. Mohamed

Thariq, Dean, Faculty of Technology, SEUSL; Ms. Nushrath Najimuddin, Junior Research Scientist, Foundation for Environment Climate and Technology; Dr. N.W.A.N.Y. Wijesekara, Medical Officer, Disaster Preparedness and Response Division, Ministry of Health, Nutrition and Indigenous Medicine; Mr. P. Rajeevkarana, Postgraduate Student, University of Moratuwa; Mr. Ruchira Lokuhetti, Junior Research Scientist, Foundation for Environment Climate and Technology; and Dr. T.T.S. Wickramarachchi, Medical Officer, Disaster Preparedness and Response Division, Ministry of Health, Nutrition and Indigenous Medicine, Colombo.

The overall programme of the Roundtable was conducted in six technical sessions, respectively chaired by Prof. Dr. M.M.M. Najim of SEUSL, Sri Lanka; Dr. Kaushal Keraminiyage of UK; Dr. M.G. Mohamed Thariq of SEUSL, Sri Lanka; Dr. Lareef Zubair of Foundation for Environment Climate and Technology, Rajawella, Sri Lanka; Prof. Biswajeet Pradhan of UPM, Malaysia; and Dr. Muditha Liyanagedara of NASTEC, Sri Lanka. The Concluding Session was chaired by Prof. Dr. Chandima Gomes of UPM, Malaysia.

The technical programme commenced with a Keynote Address by Dr. Chandima Gomes of UPM on 'Living with Extreme Natural Events: Avoiding Disasters'. The other scientific presentations



(Contd. from Page 3 - IRENE, Colombo, Sri Lanka)

made by the foreign delegates during the Technical Sessions were on 'Mitigation of Natural Events Disasters in Egypt using Seismic and GPS data' by Prof. Dr. Salah M. Mahmoud; 'Climate Change and its Impact on the Economic Sectors in the Rural Areas of Karnataka - Need for Multi-Pronged Approach' by Dr. B. C. Prabhakar; 'Risk of Lightning and Mitigating its Impact in the Eastern Indian State of Odisha' by Dr. Bikasha Chandra Panda; 'Landslide Risk Assessment and Real Time Monitoring for minimizing the Impact of Rainfall Induced Landslides in Indian Himalayas' by Dr. Debi Prasanna Kanungo; 'Working Out Ways to find Commercially Viable Measures to develop Water Resources in the Face of Climate Change and Recurring Droughts in India' by Dr. K. N. Radhika; 'Advanced Forecasting Capability of Hydro-Meteorological Disasters' by Dr. Krushna Chandra Gouda; 'Lightning, an Extreme Natural Event causing Loss of Life and Property' by Dr. Ravindra Arora; 'An Assessment of Flood Vulnerability using Risk Matrix Method- A Case Study of Kanniyakumari District, Tamil Nadu' by Prof. V. Madha Suresh; 'Restoration Opportunities Assessment Methodology (ROAM) for Landscape Stewardship from Natural Disasters: A Way Forward' by Ms. Rashmi Srivastava; 'Role of Science and Technology Communication in Disaster Risk Reduction and Awareness' by Dr. Finarya Legoh; 'Assessment of Desertification, (Extreme Natural Events) in Iran by ANN & IMDPA Model' by Dr. Ali Reza Nejadmohammad Namaghi; 'Salinization of Agricultural Resources: A Natural Disaster in Irrigated Agriculture' by Prof. M. Kafi; 'Seismicity Evaluation of Southern Iraq' by Mrs. Noor Adnan Jasim; 'Kelantan Big Yellow Flood 2014: Impacts and Mitigation' by Mrs. Nik Noorhayati Nik Abdul Majid; 'An Overview of Mauritius, the Hazards being faced due to Extreme Natural Events and the Counter Measures being undertaken' by Mr. Damonsing Jerry Robin; 'The Impacts of Extreme Natural Events: S&T Awareness, Development and Education in Myanmar' by Dr. Myat Soe Aung; 'Mitigation Technologies for Disaster Risk Reduction in Nepal' by Prof. Dr. Jiba Raj Pokharel; 'Socio Economic Assessment of Surface Deformation due to Pasni Earthquake Detected by Optical and RADAR Remote Sensing' by Dr. Muhammad Imran Shahzad; 'The Extreme Natural Events: Science & Technology for Mitigation in Palestine' by Mr. Imadoddin Al-Baba; 'Enabling Rapid Disaster Response using Artificial Intelligence and Social Media' by Dr. Muhammad Imran; 'The SSA-GEM Seismic Hazard Model for The East African Rift' by Dr. Raymond John Durrheim; 'Physical Flood Vulnerability Mapping using the Analytical Hierarchy Process Method and Geography Information System: Application to the

Savannah Region, Togo (West Africa)' by Dr. Komi Kossi; 'Success and Failures of Disaster Induced Resettlements: The Role of Science and Technology' by Dr. Kaushal Keraminiyage; 'A Review on key challenges towards Risk Reduction Science and Innovation Plans' by Dr. Nuwan Dias; 'Applying Robust Decision Making (RDM) to ensure Robust Flood Management in Ho Chi Minh City, Vietnam' by Dr. Bach Tan Sinh; and 'The Use of Remote Sensing and GIS for Drought Assessment: The Case of Southern Province' by Mr. Lusekelo Kasungu.

The presentations made by the Sri Lankan participants were on 'Impact of Extreme Climate on Crop Production and Management Techniques in Batticaloa District, Sri Lanka: Review on Flood and Drought' by Mr. A. Narmilan; 'The Effect of Floods on Livestock in Ampara District in Sri Lanka' by Ms. E. Pavithira; 'Long-term Temperature Trends in Climatological Zones of Sri Lanka' by Mr. G. Naveendrakumar; 'Understanding Connections between Climate, Extreme Weather, Air Quality, and Health with a Glance at Sri Lanka' by Dr. H. K. W. I. Jayawardena; 'Coastal Morphodynamics of Natural Hazard: A Case Study of Oluvil Area in Ampara District, Sri Lanka' by Mr. K. Nijamir; 'Cyclonic Storm Roanu and the Orographic Rainfall Mechanism triggered the Landslide in Aranayaka in May 2016' by Dr. Lareef Zubair; 'The Effects of Flooding in Kaluwanchikudy DSD: An Analysis Using GIS Application' by Mr. S. Mathanraj; 'Seasonal impact of Climate on Tea Production in Sri Lanka' by Ms. Nushrath Najimuddin; 'Use of Traffic Light signs to indicate Status of Emergency: An Innovative Visual Management tool for Health sector' by Dr. N.W.A.N.Y. Wijesekara; 'Influence of Matrix Suction on Pullout Resistance of Soil Nails' by Mr. P. Rajeevkarana; 'Drought Monitoring for Sri Lanka: Spatial Extent and Temporal Evolution during the 2016-17 Drought' by Mr. Ruchira Lokuhetti; and 'Ensuring Continuity of Health Service Provision and promoting Health of Communities during Drought Situations: Circular Guidelines by Ministry of Health' by Dr. T.T.S. Wickramarachchi.

The Concluding Session of the Roundtable was chaired by Dr. Chandima Gomes, UPM, Malaysia wherein extensive discussion on a draft Colombo Resolution on 'Mitigation of Impacts of Human Hazards due to Extreme Natural Events: Five Year Road-Map on the Adoption and Development of Scientific & Technological Advancements' was initiated by Prof. Arun P. Kulshreshtha, DG, NAM S&T Centre and comments/inputs from the participants were then incorporated in the draft after deliberations. The finalised Resolution was then unanimously adopted by the participants for its

submission to the concerned ministries, agencies and other authorities in their countries. This was followed by the distribution of Certificates by Prof. Kulshreshtha to the Roundtable participants and the Session got concluded with the Vote of Thanks delivered by Dr. Muditha Liyanagedera, Director and CEO, NASTEC.

In order to leverage the learning and experience, a field visit was arranged for the foreign delegates to a Landslide site at Kahagalla in Central Province of Sri Lanka.

The participants expressed their gratitude to the organisers and hosts, NASTEC and RC-TDP of SEUSL for the excellent arrangements and efficient coordination during the Roundtable.



Field Visit to Kahagalla Land Slide Site

## *DISTINGUISHED VISITORS TO THE CENTRE*

<b>2<sup>nd</sup> November 2017</b>	<b>Dr. Akram Ghadimi</b> , Director, Science Popularization Department, National Research Institute for Science Policy (NRISP), Iran (along with two colleagues)
<b>9<sup>th</sup> November 2017</b>	<b>Prof. Dr. Birol Kilkis</b> , Fellow ASHRAE, Sustainable Energy Systems, Department of Mechanical Engineering, Faculty of Engineering, Baskent University and <b>Associate Prof. Dr. Siir Kilkis</b> , Scientific Programs Expert, Science, Technology and Innovation Policy Department, TÜBITAK, Ankara, Turkey
<b>9<sup>th</sup> November 2017</b>	<b>Dr. A.R. Shivkumar</b> , Senior Scientist, Karnataka State Council for Science and Technology, Indian Institute of Science, Bengaluru, India
<b>30<sup>th</sup> November 2017</b>	<b>Dr. Purnima Sharma</b> , Managing Director and <b>Dr. Vibha Ahuja</b> , Chief General Manager, Biotech Consortium India Limited (BCIL), New Delhi, India

## Colombo Resolution

### ON MITIGATION OF IMPACTS OF HUMAN HAZARDS DUE TO EXTREME NATURAL EVENTS: FIVE YEAR ROAD-MAP ON THE ADOPTION AND DEVELOPMENT OF SCIENTIFIC & TECHNOLOGICAL ADVANCEMENTS

**RECOGNIZING THAT** the natural extreme events prevalent in most countries lead to the loss of thousands of lives and billions of dollars in the form of property and environmental damage, the mitigation of which requires innovation of new technological advances and immediate intervention, improvisation and adoption of existing technologies through collective efforts, and knowledge & resource sharing among the regional countries experiencing similar types of disasters;

**RECALLING THE SEVERITY** of several incidents, for example, recent floods, landslides, droughts and earthquakes in India, Indonesia, Iran, Iraq, Jordan, Malaysia, Mexico, Nepal, Pakistan, Sierra Leone, Sri Lanka, and Thailand;

**IDENTIFYING** the extreme natural events that adversely affect most of the countries in the world which include Cyclones and Heavy Precipitation, Prolonged Droughts, Earthquakes and Volcanic Eruptions, Thunderstorms and Lightning, Hailstorms, Dust Storms, Cloudbursts and GLOF, Wind Gusts, Gales and Tornadoes, Heat and Cold waves, Acid Rains and Tsunami;

**REALIZING THAT** each of the above phenomena may give rise to one or more of the adverse effects that lead to loss of human lives and sufferings due to Flash Floods, Landslides, Impacts on Forestry and Vegetation, Impacts on Water Resources, Effects on Man-Made Structures, Health and Sanitation Issues, Impacts on Fisheries Industry, Impacts on Agriculture, Deterioration of Surface Topography and Man-Made Structures;

**FURTHER ACKNOWLEDGING** the scientific and technical advancements available at present for adoption as measures of mitigating the adverse effects due to extreme natural events including Advanced Forecasting, Nowcasting and Early Warning Systems; Qualitative and Quantitative Prediction of Adverse Effects; Space-Borne, Air-Borne and Terrestrial Remote Sensing; Mapping, Zoning and Simulation by GIS; Topographic Studies by Ground-Based & Airborne Platforms; Monitoring and Surveillance Systems; IT-Based Coordination Networks for Disaster Risk Reduction; Disaster-Resilient Housing and Sheltering; Earth Stabilization Techniques; Disaster-Resilient Electrical Systems; Urban Planning for Disaster-Resilient Living; Protection Systems and Safety Structures; Smart Evacuation Techniques; Chemical or Physical Treatment for Safety and Recovery; Sociological Measures for Disaster Mitigation; and Public Communication on S&T and Buffer Zoning to prevent Public Activities in Potentially Hazardous Areas;

**WE, THE DELEGATES OF THE INTERNATIONAL ROUNDTABLE** on the Impact of Extreme Natural Events: Science and Technology for Mitigation (IRENE), jointly organized by the Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre), New Delhi, India, the National Science and Technology Commission (NASTEC), Sri Lanka and the Research Centre – Technology for Disaster Prevention (RC-TDP), South Eastern University of Sri Lanka, held in Colombo, Sri Lanka from 13<sup>th</sup> to 15<sup>th</sup> December 2017, representing 18 countries including Egypt, India, Indonesia, Iran, Iraq, Malaysia, Mauritius, Myanmar, Nepal, Pakistan, Palestine, Qatar, South Africa, Sri Lanka, Togo, the UK, Vietnam and Zambia;

**AFTER EXTENSIVE DELIBERATION** on various facets of transferring science and technology for mitigating hazards due to extreme natural events unanimously resolve to propose the following Five-Year Road-Map with implicit understanding that while the main stakeholder of this task is undoubtedly the Government, the success depends on the involvement and devotion of a large spectrum of stakeholders that include non-governmental organizations, R&D sector and experts in the field, academia, social workers, local authorities and many elements of each societal layer:

- ❖ Each country or region establishes an Activity Centre(s) (research, awareness or technical / consultancy services) affiliated to the Government, NGO, academia or standalone to address the relevant issues;
- ❖ An international or regional hub(s), possibly selected among the above Centres, is recognized to facilitate inter-institutional communication, networking, joint activities and regional collaborations, knowledge sharing and resource optimization;
- ❖ Each Centre acts as a knowledge and networking hub for the communities in the respective country or region;
- ❖ Each Centre identifies the most likely extreme natural events and their consequential adverse effects in the respective country or region and educate the concerned stakeholders regarding the risks and threats in pre- and post- disaster scenario;
- ❖ Each Centre formulates, or adopts from the knowledge bases of other Centres, the latest technological advancements available to mitigate identified potential adverse effects due to natural extreme events in their respective countries or regions;
- ❖ The Centres individually or collectively approach the R&D sector and academia to encourage the relevant parties in inventing, innovating, improvising and adopting appropriate technologies to address the disaster related issues;
- ❖ The Centres individually or collectively develop a dialogue between the researchers and funding agencies to support the projects in the concerned areas;
- ❖ Each Centre builds up a close and cordial relationship with the government agencies to make them aware of the needs of the country or region and draw their attention in developing appropriate policies and guidelines;
- ❖ Each Centre works to seek funding from state and private sectors for research and development, awareness promotion, communication activities and international events to educate the local, regional and international communities regarding the technological and scientific solutions available for disaster risk reduction.

The participants of the Roundtable warmly applauded the proposal of Prof. B C Panda of Indira Gandhi Institute of Technology, Sarang, Odisha, India to explore in-principle the possibility of establishing a dedicated NAM S&T Centre for Lightning Research, Detection and Protection (CLRDP) with the involvement of the State and Central Governments of India.

**Thus, adopted this day, the 14<sup>th</sup> of December 2017, at Colombo, Sri Lanka.**

(Contd. from Page 1 - SFSA Conference, Pretoria)

The SFSA Conference was the third progressive step in creating a large-scale public platform for debating the science and society interface. South Africa intends to utilise it as a vehicle to strengthen its strategic international STI partnerships. The event brought together ~2,700 scientists, researchers and intellectuals from 60 countries and a number of multilateral organisations for exchanging ideas on the interface between science, technology and innovation in building a better society and showcasing the latest science innovations in the country, as well as for business enterprises to look out for future opportunities. Some of the prominent speakers were: HE Mr. Cyril Ramaphosa, Deputy President of the Republic of South Africa; Prof Sarah Anyang Agbor, African Union Commissioner for Human Resources, Science and Technology; Honourable Andrew Wheatley, Minister of Science, Energy and Technology, Jamaica; Mr. Robert-Jan Smits, Director General of the European Commission for Research, Innovation and Science; Her Excellency Dr. Itah Kandjii-Murangiri, Minister of Higher Education, Training and Innovation, Namibia; and Her Excellency Dr. Maria do Rosario Braganca Sambo, Minister of Higher Education, Science, Technology and Innovation, Angola.

Six professionals and S&T managers were sponsored by the NAM S&T Centre from among its member countries to attend the SFSA 2017, namely, Dr. Win Naing Tun, Director and Head of Administration, Department of Research and Innovation, Ministry of Education, Yangon, Myanmar; Prof. Jiba Raj Pokharel, Vice Chancellor, Nepal Academy of Science and Technology (NAST), Nepal; Prof. Lucy Jumeiyi Ogbadu, Director General/CEO, National Biotechnology Development Agency, Abuja, Nigeria; Dr. Abueid Mohammed, DG, Technical Development Directorate, Higher Council for Innovation and Excellence (HCIE), Ramallah, Palestine; Prof. Weerathunga Arachchige Janendra Mathalee De Costa, Senior Professor of Crop Science, Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka; and Mr. Zulu Filipo, Manager, National Science and Technology Council, Lusaka, Zambia. The NAM S&T Centre was represented in the Conference by Prof. Dr. Arun P. Kulshreshtha, Director General and Ms. Meenu Galyan, Research Associate.

In her welcome speech, H.E. Mrs. Naledi Pandor, Hon'ble Minister of Science & Technology, South Africa emphasised upon three objectives of SFSA 2017, namely, putting science at the service of African society in order to address many of the challenges faced by their communities through science; promoting international collaboration so that ties are strengthened and science not only becomes stronger in Africa, but internationally, and that groundbreaking research is enabled; and showcasing African science and technology to the world.

The Science Forum's programme included a keynote speech, two plenary sessions and 71 parallel sessions, as well as a round showcasing of various products in 69 exhibition booths. In addition, 32 Science Talk Sessions were organised in which speakers presented their papers on different topics, some of which were: Towards an Open Science Framework for African Countries; The Importance of The Living Wage; Innovative Leadership for Development; How to Co-create a Leading and Sustainable Tech Start-Up Incubator; Research Challenges Identified by The Wind Industry; Innovating Ideas and Leading Practices in Science Communication; Africa Rocks: Earthquake Research in Deep South African Gold Mines; 5<sup>th</sup> Generation Wireless ICT - Eco-system and Its Impact on Industry Applications; Steps Towards Life: Chemistry; Empowering Communities to tackle their Challenges by harnessing Science and Technology; The Role of a Professional Registering Body in a National System of Innovation; Seabed Science and Secrets from the Deep; Sasol Solar Challenge Session; Climate Change: A Shared Responsibility; Representation Matters: Black Women in Science; Women in STEM: Lessons from the Howard University Republic of South Africa Project; A Network of Compact Advanced Light sources in Africa; Translating Compounds from African Medicinal Plants into Actual Drug Candidates; An Outsider's Optimism for Innovation in South Africa; A Joint Agenda Setting System for Research Uptake and Resource Mobilisation in the Food and Agriculture Sector; Sharing Data Internationally and How to Reward Such Efforts; African Plants: A Source of Beneficial Chemicals; Using the 2020 Olympics to Demonstrate a New Technology; The Science and Politics of Water Management; Commercialising Academic Research; Combination of Culture and Science – Practice in China and Prospection on China South Africa Cooperation; Awesome South African Inventions; etc. Prof. Arun P Kulshreshtha, Director General, NAM S&T Centre presented a

paper titled 'South-South Cooperation for Collective Self Reliance of Developing Countries and Science Diplomacy – The Role of NAM S&T Centre' in one of the Science Talk Sessions.

Prof. Kulshreshtha was also a Panel member in the Closing Plenary Session on 'Role of Government' and 'Role of International Research Organisations' in which he made a Statement titled 'Enhancing Research and Innovation: The Role of Government and International Research Organisations', which provided a glimpse of the Centre's activities over last thirty years of its existence which has grown to be a well established international entity for promoting South-South, and also to a limited extent, North-South cooperation in science and technology, acting as a think tank and a clearing house of information on the technological capabilities of the developing countries. Prof. Kulshreshtha took this opportunity to extend cordial invitation to all the developing countries to join the NAM S&T Centre and as a win-win proposition, take advantage of its wide ranging scientific activities to help in facilitation of achieving their sustainable development goals through Science, Technology & Innovation.

In her closing remark, Hon'ble Minister Pandor made a number of policy announcements. In a bid to boost the training of the next generation of scientists and researchers on the continent, the Minister announced the establishment of five new research chairs at



GROUP PHOTO OF PARTICIPANTS AT SCIENCE FORUM SOUTH AFRICA (SFSA), PRETORIA, 7-8 DECEMBER 2017 SPONSORED BY NAM S&T CENTRE

the universities around Africa in commemoration of the 100<sup>th</sup> year anniversary of the birth of Oliver Tambo. Further, as political support and appreciation of science is critical, the Department of Science and Technology (DST) of South Africa, in partnering with UNESCO, decided to facilitate a science and technology policy orientation course for parliamentarians, early in 2018 in anticipation of a significant rise in the number of parliamentarians participating in next year's Forum. She also said that the DST will strategically leverage South Africa's current leadership of the Southern African Development Community (SADC) to support the development of national and regional innovation systems.

Besides the Forum deliberations, South African Science Diplomacy Awards were also announced in the Closing Ceremony to celebrate partnerships that have made a noteworthy contribution in making the world a better place. These Awards were conferred upon several scientists as recognition of their excellence and achievements in international scientific cooperation. Prof. Arun P. Kulshreshtha, Director General, NAM S&T Centre was honoured with the Science Diplomacy Award for International Peace, Understanding and Solidarity.

Each of the SFSA participants sponsored by the NAM S&T Centre submitted an abstract of paper for presentation during the Forum programme. One such paper contributed by Prof. Dr. Lucy J. Ogbadu, Director-General/CEO, National Biotechnology Development Agency, Abuja, Nigeria is reproduced at the following page.



## IGNITING CONVERSATIONS ABOUT SCIENCE: CONCERN OVER THE LAG IN BIOTECHNOLOGY RESEARCH IN AFRICA#

**Lucy J. Ogbadu\* Ph.D.**

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*\*(Material for Presentation at the Science Forum South Africa (SFSA):  
Igniting Conversations about Science, Pretoria, South Africa, 7-8 December 2017)*

Africa accommodates 15% of world population and even with all her endowments in human and natural resources are lagging behind others in development as a continent, recording only 5% of global GDP. This position is closely tied to the status of her Science, Technology and Innovation (STI) as illustrated as follows: The average expenditure to Research and Development by Africa stands at 0.45% whereas global average is 1.7%; Africa's contribution to the pool of researchers and global patents each stands at 0.1%. This situation has been identified by Africa Union as the major issue hampering her development and therefore came up with a well thought out policy on STI known as the Science Technology and Innovation Strategy for Africa (STISA) which prescribes the commitment of funds up to 1% of National Gross Domestic Product to STI by member nations. Only through such bold step can Africa build capacity for value addition to her numerous natural resources and consequently increase her GDP. For STISA to succeed, four pillars have been identified namely: 1) Upgrading/or Building of world class science infrastructure; 2) Enhancing technical and professional competencies; 3) Innovation and entrepreneurship development; and 4) Provision of enabling environment. It is unequivocal that developed countries are those at the forefront of countries with heavy investment in STI and consequently high research intensities.

At the last gathering of African scientists under the aegis of the 13<sup>th</sup> Annual meeting of African Science Academies (AMASA) to mark the 40<sup>th</sup> anniversary of the Nigerian Academy of Science (NAS) in November 2017 at Abuja, it turned out to be a lamentation conference as speaker after speaker bemoaned the failure of African countries in ensuring the erection of the STISA pillars. Only Malawi in Sub-Saharan Africa has been able to invest up to 1% of her GDP (1.06%) in STI. There are genuine concerns over this situation as STI is viewed as the wheel of development, an understanding which has attracted serious, long term development plans and investment by advanced countries in strategic technologies such as Nanotechnology, Biotechnology, Information Technology and Cognitive science (NBIC) classified and acknowledged as the driving technologies of the millennium.

Biotechnology is capital intensive because of the attendant high cost of equipment and reagents for modern biotechnology research. Infrastructure deficit, power outage and dearth of critical mass of personnel are the major issues that require fund investment. In terms of research funding, Africa was better off 2-3 decades ago even without external funding assistance. Presently, African countries particularly those in East Africa attract some level of foreign funding of research ranging from 47-70%. Despite these efforts on financial assistance to Africa in STI development, there is little or insignificant impact of STI on Africa's GDP, instead the gap between Africa and the rest of the world in STI appears to be widening.

This scenario informed the decision by UNIDO to establish the International Centre for Genetic Engineering and Biotechnology (ICGEB) to address the widening gaps between developed and developing countries in biotechnology research with strategies of awarding Grants, Fellowships and mounting Trainings in topical issues of the technology. The unfolding outcome of this strategy which is globally competitive appears to be a paradox in achieving the goal, as African scientists are losing out as a result of the quality of their submission. Whereas Europe records up to 42% and Central America 10% beneficiaries from ICGEB fellowship programs, sub-Sahara Africa enjoys only 8% while Asia and Latin America enjoy 22% and 11% respectively. International Centre for Genetic Engineering and Biotechnology (ICGEB) now operates two other centres in New Delhi, India and more recently in Cape Town, South Africa in addition to the pioneer centre in Trieste, Italy. Calls have gone out presently for application to establish regional centres to be funded by hosting countries, all in the effort to promote active participation in biotechnology research globally but response from Africa is poor. From my observation since joining the board of governors of ICGEB, the New Delhi centre is generating copious results that are out to address regional health challenges and more. It is expected that biotechnology research in African institutions would equally target challenges that are peculiar to Africa and many more.

In conclusion, it will profit Africa to commit resources to biotechnology research. The way forward therefore is for sustained commitment by African countries in line with STISA prescription. The fund would be well utilized when invested in: human capacity development, establishing research infrastructure at institutions and centres of excellence, collaboration and partnership development, establishing regional equipment/reagent manufacturing /maintenance hubs. It would be necessary to take certain steps preceding these steps by developing a culture of copious appreciation of importance of the technologies, undertaking complete overhaul of out-dated curricula and creating enabling environment through evidence-based policies and setting research priority agendas. The overall plan must also take into consideration the important roles that African Diaspora have to play by lending support of their expertise and investment of resources.

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*\*Lucy Ogbadu is a Professor of Microbiology and the Vice-President ICGEB*

## Research Training Fellowship for Developing Country Scientists (RTF-DCS) 2016-17

### Cameroon - Project Completion Report of Mr. Ntieche Benjamin



**Mr. Ntieche Benjamin**, Assistant Lecturer, University of Yaounde I, Higher Teacher Training College, Geology laboratory, Yaoundé, Cameroon was sponsored by the NAM S&T Centre under its RTF-DCS Fellowship scheme for 2016-17 to carry out research in the Geochemistry Division, CSIR-National Geophysical Research Institute, Hyderabad, India on a project titled '**Granitoids and Associated Mafic Rocks of Njimom-Manki Area: Geochemistry, Mineralogy and Associated Mineralization**' under the supervision of Dr. M. Ram Mohan.

The study was divided into three sections, namely: Petrography, Structural Geology and Geochemistry. The prime objective of the study was to understand the processes of crustal evolution and the emplacement mechanism of the granitoids of the Njimom-Manki area in West Cameroon, Central Africa.

Petrology and geochemistry were done at the Geochemistry and Petrology laboratories of the CSIR-NGRI to constrain the detailed lithological associations of the study area, characterize structural elements (deformational features based on kinematic indicators), and the geochemistry (major and trace elemental systematics).

The results of the study can be summarized as follows:

The study area consists of six rock types variably affected by deformation: (i) Coarse-to-fine grained granites with mainly porphyritic texture, (ii) Migmatites with grano-porphyroblastic texture, (iii) Orthogneisses exhibiting porphyroblastic to grano-lepidoporphyroblastic textures, (iv) Amphibolite with granoblastic texture, (v) mafic dykes with cataclastic texture, and mylonites showing granoclastic, ocellar mylonitic and cataclastic textures.

The rocks of the studied area experienced four stages of deformation: (i) The first stage (D<sub>1</sub>), characterized by foliation (S<sub>1</sub>), corresponded to tangential movements; (ii) the second (D<sub>2</sub>) overprinted by D<sub>3</sub> phase, is a heterogeneous simple shear in dextral transpressive regime; (iii) the D<sub>3</sub> tectonic phase is the main tectonic event, marked by sinistral transpressive movements. It is a shearing phase with a NE-SW direction and also the phase of superposed folding; (iv) D<sub>4</sub> stage is a brittle phase which at the regional scale, is contemporaneous with the Central Cameroon Shear Zone. The brittle deformation is younger than the foliations and the region experienced ductile to brittle transition deformation.

The granitoids are I and A type granites and mostly granodiorite, syenite, monzonite, quartz-monzonite, gabbro, monzodiorite and are metaluminous.

Geochemical systematic define the derivation of these rocks from both igneous and sedimentary protolith, probably in a subduction-to collision related environment.

### Egypt - Project Completion Report of Mr. Mohd. Reda M. Abd El-Naby Ismail



**Mr. Mohd. Reda M. Abd El-Naby Ismail**, Maize Breeder in Maize Research Department, Agricultural Research Center, Egypt was sponsored by the NAM S&T Centre under its RTF-DCS Fellowship scheme for 2016-17 to carry out research in the International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi, India on a project titled "**Designing Glyphosate Tolerant Maize Lines employing CRISPR/Cas9 Mediated Genome Editing of EPSPS and Over Expression of GOX Genes**" under the supervision of Dr. Tanushri Kaul from 1<sup>st</sup> February 2017 to 28<sup>th</sup> July 2017. The main objective of the research was to develop herbicide tolerant maize lines by using convenient, highly efficient CRISPR/Cas9 genome editing system.

Weed infestation is one of the major biotic stress factors responsible for yield loss in crop plants.

Glyphosate (N-[phosphonomethyl]-glycine) is potent and most widely used broad-spectrum herbicide that interferes with shikimate pathway by inhibiting 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS). In plants and most bacterial EPSPS enzymes there is a conserved motif crucial for binding phosphoenolpyruvate (PEP) or its competitive inhibitor glyphosate, the active ingredient in Roundup. Here the developing of efficient herbicide resistant maize lines by site-specific EPSPS gene fragment replacement with insertion of desired HDR template (Homology Donor Repair) through CRISPR/Cas9 system has been reported. The CRISPR/Cas9 system has been demonstrated to efficiently induce targeted gene editing in a variety of organisms, including plants. A plasmid was designed (pCAMBIA1300 backbone) that harbours cassettes expressing plant codon optimized Cas9 from *S. pyogenes* and two Zm-EPSPS-sgRNAs. Zm-EPSPS-gRNA cassette (539 bp) was synthesized and sub-cloned via 5' BsaI/ 3' BsaI into Cas9 plasmid by Golden gateway method, renamed plasmid as pPCOCAS9-gRNA (15,757 bp). The Cas9 was under the control of maize Ubiquitin promoter and two gRNAs were driven by rice U3 & U6 promoters. Homology donor fragment (1084 bp) contained several features for HDR mediated mutated EPSPS gene replacement assembled in pZmU3 vector. The CRISPR/Cas9 constructs were transformed into *Zea mays* by using gene gun approach. Putative T0 transgenic maize lines were transferred to greenhouse under controlled conditions. Further, functional validation of mutations in native EPSPS gene and glyphosate resistance in these putative maize lines shall be duly performed.

The objective of the study was to develop herbicide tolerant maize lines by using convenient, highly efficient CRISPR/Cas9 genome editing system. Mature seeds of maize inbred lines KDM 111 were used for callus induction. Surface sterilized seeds were cultured in seed germination medium. The immature embryos about 1.0 – 2.0 mm were excised from 2 days grown seeds and placed on callus induction medium (0.5mg/l 2, 4-D + 2.5mg/l picloram).

A plasmid was designed (pCAMBIA1300 backbone) that harbours cassettes expressing plant codon optimized Cas9 from

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*S. pyogenes* and two Zm- EPSPS- sgRNAs. Zm-EPSPS-gRNA cassette (539 bp) was synthesized and sub-cloned via 5' Bsal/ 3' Bsal into Cas9 plasmid by Golden gateway method, renamed plasmid as pCOCAS9-gRNA (15,757 bp). The Cas9 was under the control of maize Ubiquitin promoter and two gRNAs were driven by rice U3 & U6 promoters. Homology donor fragment (1084 bp) assembled in pZmU3 vector. The cassettes were isolated from plasmids after digestion with appropriate restriction enzymes and the restriction fragments were separated using 0.8% agarose. The gel slice containing the minimal cassette was excised and DNA was purified.

Microprojectile bombardment; Cassette DNA fragments at 100 ng was precipitated, respectively on 1.8mg gold particles (0.6  $\mu$ m diameter; Bio Rad, Hercules, CA). Bombardment was performed using the PDS- 1000/He particle delivery system (Bio-Rad). Callus cultures were bombarded once and incubated in a dark chamber at 25  $\pm$  2C. For stable transformants the calli were cultured in selection medium. After three round of selection the proliferated calli were transferred to shoot regeneration (MS medium with BAP 1.5mg/l + IAA 0.5mg/l) and rooting medium (MS medium with 1.5mg NAA).

Genome Editing of EPSPS from *Zea mays* for Glyphosate Tolerance – Using Golden Gate cloning strategies, pYLCRISPR/Cas9 constructs were prepared, carrying ZmEPSPS- gRNA expression cassettes driven by the OsU3 and OsU6 promoters and Homologous donor fragment assembled in pZmU3 vector for gene targeting in maize. These constructs were transferred into maize callus by biolistic mediated transformation. Putative transgenic T0 lines are transferred into green house under control circumstance. Further, molecular and biochemical validation in these putative maize lines shall be duly performed. The events were later sent for sequencing.

### Mongolia - Project Completion Report of Ms. Odgerel Bumandalai



**Ms. Odgerel Bumandalai**, Researcher, Microbial Synthesis Laboratory, Institute of General and Experimental Biology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia was sponsored by the NAM S&T Centre under its RTF-DCS Fellowship scheme for 2016-17 to carry out research in the Central University of Punjab, Bathinda, India on a project titled “**Molecular Taxonomic Identification of Microalgae Species isolated from Mongolia**” under the supervision of Dr. Felix Bast from 16<sup>th</sup> March 2017 to 10<sup>th</sup> September 2017. The main objective of the research was to study the molecular taxonomic identification of microalgae species isolated from Mongolia.

Microalgae are a diverse group of organisms, found widely in aquatic and some terrestrial habitats. They are known to respond differently to environmental stresses, which made them a one of the key objects for understanding the processes of ecosystems, nature conservation, and food product regulations. They are often used as major or minor ingredients in production of fuels, food and animal feed, colorant, chemicals and functional components of cosmetics and pharmaceutical products. Nevertheless, the identification of green microalgae can be a complicated task and requires careful microscopic examinations of living cells by specialists. Although for many decades green microalgae have been mainly identified on the basis of their morphological features, they are still poorly understood taxonomically and phylogenetically due to the absence of distinct structural features among species. Therefore, to overcome these issues, molecular techniques are used for revealing the diversity of microalgal species.

DNA bar-coding is the most promising approach for fast and accurate species identification, which is based on DNA sequence similarity against a sequence database of a preceding defined species. In this study, we present a comprehensive DNA barcode analysis of *Dunaliella* and *Chlorella*-like species based on three gene loci *rbcL*, *tufA*, and ITS. Publicly available sequences were exploited in this study to evaluate species identification of microalgae strains. The objective of this study is to identify Mongolian species of *Chlorella* and *Dunaliella* strains for the first time using phylogenetic analyses of chloroplastic and nuclear genes.

The microalgae strains were obtained from the culture collection at the Institute of General and Experimental Biology, MAS, Mongolia. A total of 10 strains were analysed in this study. Total genomic DNA was extracted from 100 mg fresh cultures using HiPurA™ Algal DNA Purification Kit (MB561; HIMEDIA®, Mumbai, India) and the conserved DNA regions corresponding to 18S rDNA, ITS rDNA, *rbcL*, and *tufA* genes were amplified using universal primers. The PCR products that provided a single band of sufficient intensity after running a 1.5 % agarose gel were sent for Sanger sequencing. As a result, the gene sequences for the studied strains were highly similar to other strains of *Chlorella vulgaris*, *Chlorella parva*, *Parachlorella kessleri*, *Chloroidium saccharophilum*, *Dunaliella parva* and *Dunaliella bardawil*. In addition, the combination of different characteristics in an integrative approach helps to clearly identify microalgae at genetic and species levels.

### South Africa - Project Completion Report of Mr. Amoo Oseni Taiwo



**Mr. Amoo Oseni Taiwo**, Postgraduate Candidate of Civil Engineering and Surveying Department of Durban University of Technology, Durban, South Africa was sponsored by the NAM S&T Centre under its RTF-DCS Fellowship scheme for 2016-17 to carry out research at National Institute of Hydrology (NIH), Roorkee, Uttarakhand, India on a project titled 'Integrated Hydrological Modeling for Sustainable Water Resources Allocation Plans for MKomazi Watershed Management' under the supervision of Dr. Sharan K. Jain from 11<sup>th</sup> February to 5<sup>th</sup> August 2017. The main objective of this research was to explore the

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socioeconomic and environmental consequences of water regulation in the Mkomazi River Basin in South Africa, develop a water resources allocation system and investigate the extent to which the framework is 'sustainable' in the medium and long-term. The study explores the interdisciplinary nature of water from merely employing engineering-based simulation models to apply a more holistic Pressure – State - Response framework (integration of environmental, social and economic functions) as an indicator of promising supportive sustainable management decisions in handling today and future water allocation challenge.

The research work carried out at the National Institute of Hydrology includes the use of the integrated hydrological model (Soil Water Assessment Tool), in GIS environment, to model the available water. This was calibrated and validated using SWAT-Cup- SUFI-2 algorithm. Thereafter, dependability factor of priority use was used in allocating the present and projected future water use base on population and technological advancement efficiency. Various statistical methods and tools not limited to time series, Principal Component Analysis (PCA), Factor Analysis (FA) and Agglomerative Hierarchical Cluster Analysis were used in hydrometeorological data trend detection for seasonal pattern assertion of climate change impact on streamflow regime. System Dynamic model in VENSIM environment was used to relate the top-bottom-up interactive participation in managing the basin response to socio-economic hydrological variability in the basin.

## Zimbabwe - Project Completion Report of Mr. Tinotenda Zwavashe



**Mr. Tinotenda Zwavashe**, Harare Institute of Technology, Zimbabwe was sponsored by the NAM S&T Centre under its RTF-DCS Fellowship scheme for 2016-17 to carry out research in National Institute of Wind Energy (NIWE), Chennai, India on a project titled 'On-Grid Solar PV Systems in Zimbabwe: A Comprehensive Feasibility Analysis and Roadmap Propositions for A Sustainable Future' under the supervision of Dr. Kanagavel from 2<sup>nd</sup> March 2017 to 23<sup>rd</sup> August 2017. The main objective of this research was to address energy challenges in Zimbabwe through a wider adoption of renewable energy sources, specifically solar energy.

The research came at the backdrop of electrical power shortages in the country whilst at the same time the country shows a huge potential of solar energy. Other benefits of green energy sources were highlighted as supportive reasons for advocating for solar as an energy source in the country especially the reduction in carbon emissions and support for the global drive to reduce effects of climate change due to Greenhouse Gas Emissions (GHG).

As at the end of 2016, Zimbabwe's electric utility grid benefitted from thermal and hydroelectricity with close to 62% of the generation coming from thermal, for a scenario where the power plants are generating at full capacity. However power plants have not been functioning at expected capacities and this has resulted in electric challenges across the country. Some of the key challenges being natural resource related such as significantly low water levels at times in the Kariba Dam, which is the main source of hydroelectric power. Electricity generation statistics update on the 2<sup>nd</sup> of October 2017 showcase a production of 1 173MW from all the power plants which is a shortfall by close to 38% from the expected national consumption estimated at 1 900MW. Thus the research was seeking to address this national challenge by analyzing the solar resource and grid connected solar photovoltaic system implementation feasibility based on the techno, socio and economic setup in the country.

After the definition of the problem followed the analysis of the solar resource in Zimbabwe based on satellite data. The analysis showed a huge potential of solar photovoltaic projects in the country as global irradiance values in the country varied from 5.34 kWh/m<sup>2</sup>/day to as high as 5.95 kWh/m<sup>2</sup>/day in the western and north-west parts of the country. The next stage of the research was to analyze the architecture of grid connected solar PV systems and making a comprehensive technical analysis considerations for the design and implementation of such systems for improved performance and taking into consideration the climatic and environmental conditions for a case study based on a proposed 1.8MW plant in Harare for the three PV module technologies, i.e. polycrystalline, monocrystalline and thin film. The poly PV based plant showcased Performance Ratio of about 83.4% and Capacity Utilization Factor of 18.87% which are a reflection of realisable plant performances.

An economic and financial analysis was then done based on the Annual Energy Production (AEP) values of the proposed 1.8MW plant. Key financial parameters which were used in the analysis as a measure of plant financial performance are Net Present Value (NPV), Simple Payback and Equity Payback. The simulations highlighted remarkable financial feasibility of solar PV project implementation. The analysis demonstrates that an initial system cost of \$1 500/kW yielding 2 975MWh/year gives a positive Net Present Value (NPV) of close to \$0.62 million at 10% Discount Rate for power sold at \$0.12 /kWh. The NPV increases by \$0.32 million for an increase by \$0.01 in the Cost of Electricity (COE). Simple and Equity payback periods at \$0.12 COE are 9 years and 7.4 years respectively. The reduction in Discount Rate yields higher NPV values which are estimated at \$2 million at a 5% Discount Rate and 12c COE.

Finally a study was done on the possible mechanisms by which renewable energy projects can be promoted and supported for successful implementation. Several policy and incentive mechanisms were looked at and these can be presented as recommendation to the Ministry of Energy and Power Development's renewable energy section.

## SCIENCE AND TECHNOLOGY NEWS IN THE DEVELOPING WORLD

### Brazil: Algae to depollute Sewage and produce Compost

A partnership between Brazilian researchers from EESC-USP's Department of Hydraulics & Sanitation and Dutch researchers from Wageningen University's Department of Environmental Technology has demonstrated that it is possible to convert black water – the 'heaviest' fraction of household waste consisting mainly of a relatively undiluted mixture of feces and urine from toilet flushing – into a sort of alga farm. Single-cell algae of the genus *Chlorella* feed on nutrients in this effluent. As they grow, they help to remove the pollutants it contains and simultaneously produce large amounts of biomass for uses such as composting. The main components of the feces and urine flushed from toilets include the carbon in organic matter, nitrogen and phosphorus. When large amounts of waste are dumped in watercourses, nitrogen and phosphorus cause eutrophication – the excessive growth of aquatic microorganisms, especially algae – leading to potentially serious imbalances in aquatic communities and releasing pathogens into the environment. In the sewage treatment processes most commonly used today, chemicals remove phosphorus from the water, and what is left is a sludge that cannot be used for much else. Some Brazilian States ban its use as fertiliser in agriculture and the sludge ends up being discharged into landfills, with a considerable cost of disposal. In the new process, the first step entails decentralising sewage collection, not excessively, to prevent the dilution of black water and the nutrients in feces and urine. In the reactors tested by the research team, microalgae of the species *Chlorella sorokiniana* use nitrogen and phosphorus from black water and the micronutrients present in human waste to multiply. The next step is collecting the layers of microbes that grow in the liquid. This can be done in two ways. In the Netherlands, they mostly use sedimentation, in which a polymer is used to settle the algae at the bottom of the reactor, and they can be collected from there. In Brazil, however, flotation is used. Compressed air is injected into the liquid, and bubbles form on the surface containing the algae as they float up. A mechanical scraper then collects this biomass and discharges it into a channel. Specifically, because they absorb the nitrogen and phosphorus in black water, the algae are rich in these elements, which are essential to the industrial-scale fertilisers applied today. To leverage this potential, it is necessary to use efficient biomass drying methods. If algae are stored without being dried, their cells can rupture, and the nutrients to be used at the end of the process can leak out. An advantage of using *Chlorella* in the process is that these algae are already present in nature and do not require genetic modification to do their work. Hence, there should be no problems with regard to the disposal of treated sewage into rivers and lakes. Optimising the process so that it works on an industrial scale is the next step in the studies. Field tests will be conducted at the Monjolinho sewage treatment plant in São Carlos.

*Source: Agência FAPESP Newsletter, 25<sup>th</sup> October 2017*

### Burkina Faso: West Africa's Largest Solar Power Plant

Burkina Faso, one of the world's poorest countries, produces only about 60 percent of the electricity it consumes and just 20 percent of the overall population is hooked up to the grid. Many people use wood or butane gas bottles. It imports energy from Ivory Coast and there have been difficulties obtaining supplies at times. Ghana and Ivory Coast too export electricity to the

landlocked country to meet its needs. However, West Africa's biggest solar power plant became functional in December 2017 in Burkina Faso to boost renewables and cut energy dependence on its neighbours. The 55-hectare (135-acre) plant at Zagtoui on the outskirts of the capital Ouagadougou will be able to churn out 33 megawatts, enough to power tens of thousands of homes. For the past six weeks the plant remained in a test phase with production of 14 MW, and is expected to reach a peak of 33 MW during December, sufficient sunshine permitting. The plant's 129,600 260-watt solar panels are capable of annually pumping out 56 gigawatts, equivalent to five percent of current production, into the network of national power firm Sonabel. The \$56.7 million cost of the plant has been funded via \$25 million in donations from the European Union and a loan of \$22.5 million from France's development agency. Cegelec, part of the French firm Vinci Energies, built the facility, designed to be a pilot scheme. The added power will help reduce power shortages, which greatly hamper the economy. Energy produced by the Zagtoui plant will cost about 8.4 US cents per kilowatt-hour, which is around a third of the cost to produce electricity at fossil-fuel plants. Burkina Faso hopes to meet 30 percent of its electricity needs from photovoltaic solar panels by 2030, and hopefully, become self-sufficient in electricity production. The world's biggest solar plant is a 648-MW facility in Kamuthi, in India's Tamil Nadu state. A 40-MW solar plant on a lake over a collapsed coal mine in Huainan, China, is the largest floating solar-powered generator globally.

*Source: ET Energy World, 28<sup>th</sup> November 2017*

### China: New Rice Variety for Growth in Seawater

Chinese scientists at Yangzhou University have developed several types of rice that can be grown in seawater, potentially creating enough food for 200 million people. Researchers have long been working on rice that can grow in seawater, and finally commercially viable varieties are now being tested. If even a tenth of these areas were planted with rice, they could produce 50 million tonnes of food. Around 200 rice varieties are under testing near the Yellow Sea coastal city of Qingdao in Shandong province to see which ones perform best in salty conditions. Seawater is pumped into the fields, diluted, and then channelled into the rice paddies. The researchers projected that the rice varieties would produce 4.5 tons per hectare, but one variety already showed promising results by producing 9.3 tons per hectare. There are one million square kilometres of land in China where crops do not grow because of high salinity. Scientists hope the development of the new rice will allow some of these areas to be used for agriculture.

*Source: Crop Biotech Update, 2<sup>nd</sup> November 2017*

### Egypt: Muons reveal Secret Chamber in Great Pyramid

Physicists have used muons, the by-products of cosmic rays, to reveal a large, 30-metre-long previously unidentified chamber inside the 4,500-year-old Great Pyramid in Giza, Egypt. The find is the first discovery since the nineteenth century of a major new space inside the pyramid. Egyptologists have been quick to dismiss any idea of finding lost treasure in the 30-metre-long void but experts hope that the finding will lead to significant insights into how this spectacular pyramid was built. The Great Pyramid was constructed by the pharaoh Khufu (also known as Cheops), who reigned from 2509–2483

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BC. Constructed from limestone and granite blocks, and rising to 139 metres, it is the oldest and largest of the Egyptian pyramids and one of the most impressive structures to survive from the ancient world. Whereas other pyramids from this period sit above underground burial chambers, Khufu's Pyramid contains several large rooms inside the body of the structure itself. These include the King's chamber, which still holds a stone sarcophagus, the smaller Queen's chamber and a sloping passageway known as the Grand Gallery. These large chambers were discovered in the Ninth Century AD and extensively explored but enthusiasts have wondered ever since whether there might be more hidden chambers inside the pyramid, or even whether the king's real burial chamber is yet to be found. Under the international Scan Pyramids project supervised by the Egyptian Ministry of Antiquities, researchers placed muons detectors inside and outside the pyramid to find out whether theories of a hidden space in the Great Pyramid were true. To see through the Great Pyramid, the researchers used a technique developed in high-energy particle physics: they tracked the muon particles, which are produced when cosmic rays strike atoms in the upper atmosphere. Around 10,000 muons rain down on each square metre of Earth's surface every minute. Sensitive muon detectors have been developed for use in particle accelerators, but they have also been used in the past decade or so to determine the inner structures of volcanoes and to study the damaged nuclear reactor at Fukushima, Japan. The particles are partially absorbed by stone, so any large holes in the pyramid would result in more muons than expected hitting the detectors. The researchers say that the chamber could be either horizontal or inclined, and might be made up of two or more smaller spaces. The purpose of the space is unknown, but it is suggested that it could be 'a second Grand Gallery'.

*Source: Nature, 2<sup>nd</sup> November 2017*

#### **India: Electrotunable Liquid Mirror-Window on the Wall**

The scientists from the Indian Institute of Technology, Guhawati in India and Imperial College, London in the United Kingdom have synthesised a nanoparticles-based liquid mirror that can be electrically tuned to transmit or reflect light making it potentially useful for fabricating a switchable window-mirror device. The nanoparticles in this case are metamaterials - artificially structured materials used to control and manipulate light and sound. They can make things invisible and may even catch minute details of objects that no other sophisticated optical microscope can. Although advances have been made, tuning and modulating the optical properties of metamaterials in real time remain a challenge. The researchers have developed a system containing modified gold nanoparticles and two immiscible layers of electrolytes. They then electrically tuned the assembly and disassembly of the nanoparticles by altering the applied potential. At negative potential values, the nanoparticles assembled towards the electrolyte layers, forming a dense layer; at positive potential values, the nanoparticles disassembled. Like a mirror, the dense layer reflected light, while disassembled nanoparticles transmitted light the way a window does. Exploiting these optical properties, the researchers made a prototype electrically switchable liquid window-mirror device. A coin was placed to face the liquid mirror and a currency note was placed at the back of the mirror. At positive potential values, the nanoparticles disassembled and transmitted light, showing the presence of the currency note. At negative potential values, the nanoparticles

assembled and formed a dense layer that reflected light, making the coin visible.

*Source: Nature India Alert, 25<sup>th</sup> October 2017*

#### **Jordan: World's Largest Solar Plant in Refugee Camp**

According to the United Nations High Commissioner for Refugees (UNHCR), Jordan has switched on the world's largest solar plant inside a refugee camp, providing renewable energy to nearly 80,000 Syrians. The 12.9 megawatts solar plant at Zaatari refugee camp, on the border of Jordan and Syria, will allow families to run a fridge, TV, fans and lights in their shelters, and recharge their phones to maintain contact with others abroad. The \$17.50 million project, funded by the German government, will provide electricity in Zaatari camp for up to 14 hours a day, which allows the children to continue their studies, and also for the safety of women and young girls to go about. Camp life will be made much easier. The 40,000 solar panels will not only reduce carbon emissions by over 13,000 tons a year, it will also save \$5.5 million each year in running costs, which can then be re-invested into refugee support. From nearby Azraq camp in Jordan, to Dadaab in Kenya, solar power is being deployed to provide affordable and sustainable energy solutions for tens of thousands of displaced people. In semi-arid eastern Kenya, Africa's largest solar-powered borehole - equipped with 278 solar panels - is providing 16,000 refugees in Dadaab camp with a daily average of about 280,000 litres of water, which they use for drinking, cooking and personal hygiene, according to the European Commission. In Azraq, a 2-megawatt solar farm that started operating in May - the world's first in a refugee camp - has enabled the UNHCR to provide free, clean electricity to 20,000 Syrian refugees, covering the energy needs of two villages connected to the national grid. Yet while access to clean energy for refugees and their host communities is a global priority for UNHCR, analysts say millions of displaced people still lack access to sustainable, cheap energy sources because of a lack of funding.

*Source: EQ Magazine, 15<sup>th</sup> November 2017*

#### **Kenya: New Striga Resistance Genes in Wild Sorghum**

Striga is a growing pandemic in Africa and Asia with ability to destroy a crop with up to a 100% yield loss. Today, 300 million farmers from over 25 countries in Sub-Saharan Africa incur losses in excess of US\$7 billion annually due to Striga infestation. Covering over 100 million hectares, the weed has particularly established host in key regional staple crops maize, sorghum, millet, and upland rice, greatly undermining the efforts to attain food security and economic growth. Witchweed literally sucks the life out of its host by siphoning out water and nutrients and what remains is a stunted, discolored host and inevitable death of the entire crop. Wild sorghum will however soon provide a reservoir for resistance genes against Striga. Research teams at the Plant Transformation Laboratory (PTL) of Kenyatta University jointly with the researchers of the University of Virginia have identified three wild sorghum accessions resistant to Striga hermonthica (witchweed), a parasitic plant devastating cereal production in Sub-Saharan Africa. In a regional collaborative research published in *Frontiers in Plant Science*, the team report having found potential sources of mechanical and biochemical barriers to Striga infection that could be employed

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in genetic improvement of cultivated sorghum. Wild sorghum immune to *Striga* infestation coexists with the parasite in uncultivated lands in northeastern Africa. This potential offers an opportunity to pinpoint key resistance genes in wild sorghum that can be stacked in farmer preferred varieties. This study provides a potential to increase the genetic basis of cultivated sorghum with wide-reaching implications for *Striga* control in other cereal crops by pyramiding multiple resistance genes.

*Source: Crop Biotech Update, 8<sup>th</sup> November 2017*

### **Mexico: Emerging Leader in Latin America for Distributed Solar**

A favorable regulatory environment is positioning Mexico as the top market for distributed solar in Latin America. The country is set to double its distributed generation capacity this year, with more than 300 megawatts of new installations, after Mexico's regulatory commission increased the upper limit for net metering plants to 500 kilowatts. Meanwhile, a report from the Mexican Banks Association, ABM, projected that the market for on-site, distributed energy technologies will see a compound annual growth rate of 121 percent, and is set to exceed 8 gigawatts and \$13 billion by 2025. Growth will be led by solar. That compares to the \$110 billion going into Mexican energy-related infrastructure projects in the next 15 years, according to an EY note on Mexico's National Electric System Development Program. Mexican authorities are working to foster distributed generation as a slice of its 40 percent renewable energy target by 2035. For this to happen, the country will need to get around 18 percent of its generation from solar, compared to less than 1 percent at present. Net metering will help. Net metering has already stimulated sales of sub-20-kilowatt residential solar systems, which this year could make up around 18 percent of all solar capacity in Mexico, based on GTM Research data. Commercial-scale systems, of up to 1 megawatt, could represent another 10 percent. So far, the residential solar sector in Mexico has mostly been based on homeowners buying PV systems for their own use. But companies are starting to offer financing packages as demand expands. In 2017, several larger installers in Mexico, such as Galt, Enlight and Bright, formed partnerships or received financing for portfolios of systems. Up to 4.6 million customers could benefit from below 500 kilowatt net metering arrangements. Of these, most would be commercial or industrial users, but more than 431,000 could be on residential tariffs, the association said. Residential customers can usually recoup their distributed solar investment within three years, enjoying an internal rate of return of up to 35 percent. For

commercial users, the payback period is up to seven years and the internal rate of return could be up to 25 percent. In both cases, the recovery period coincides with the financing terms offered by commercial banks.

*Source: EQ International, 14<sup>th</sup> December 2017*

### **Mongolia: Boosting Wind Capacity amid Regional Super Grid Hopes**

Mongolia has launched a series of new wind power projects to develop its huge renewable energy potential and start delivering clean electricity to other countries in the region in preparation for the creation of an "Asia Super Grid". The Mongolian government, with officials from France's state energy conglomerate Engie, held a groundbreaking ceremony in October 2017 for the first of the new wind farms, which is scheduled to be completed by the end of 2018. The 55-megawatt (MW) Sainshand plant, 460 km southeast of capital Ulaanbaatar, will help power a long-awaited industrial complex in the region, including an oil refinery. But the sparsely populated northeast Asia country, which is hugely dependent on its mineral wealth, is looking to diversify its economy by exporting green energy to neighbours China and Russia, as well as to Japan and South Korea. It initially aims to build 8,000 MW of wind capacity dedicated to power exports. The built up energy sources will be first considered for exports and will be aimed at the Asian super grid. Asia's super grid project was launched in 2011 when China, Russia, South Korea and Japan signed an initial agreement to create a cross-border power transmission network. Mongolia's existing renewable plants, including the Tsettsii wind farm also commissioned in October 2017, account for 12 percent of the country's domestic power capacity. But the government aims to raise that share to 20 percent by 2020 and 30 percent by 2030. Mongolia has licensed six wind farms and 24 solar plants, which would be enough to meet the country's renewable goals and create a surplus for exports. While Mongolia's planned expansion represents only a fraction of the 169 GW of wind capacity in operation in China at the end of 2016, its potential is huge. China's State Grid Corporation estimated last year that Mongolia's total wind and solar capacity could reach 1,200 GW. Mongolia and China discussed the construction of ultra-high voltage power lines connecting energy bases in Mongolia to load centres in China.

*Source: EQ International, 16<sup>th</sup> October 2017*

### **Morocco: Soil-based Filter Bricks for cleaning Water for Irrigation**

Researchers at Morocco's Cadi Ayyad University have made a

## *Participation of Centre's Scientists in Scientific Events*

<b>7-8 December 2017</b>	<b>Ms. Meenu Galyan</b> , Research Associate attended the third 'Science Forum South Africa (SFSA)' held in Pretoria, South Africa on the theme of 'Igniting Conversations about Science'
<b>13-15 December 2017</b>	<b>Ms. Rashmi Srivastava</b> , Research Associate attended the International Roundtable on the 'Impacts of Extreme Natural Events: Science & Technology for Mitigation (IRENE)' organised by the NAM S&T Centre jointly with the National Science & Technology Commission (NASTEC), Sri Lanka and the Research Centre – Technology for Disaster Prevention, South Eastern University of Sri Lanka (RC-TDP, SEUSL) at Colombo, Sri Lanka. She presented a paper titled "Restoration Opportunities Assessment Methodology (ROAM) for Landscape Stewardship from Natural Disasters: A Way Forward" during the Roundtable.
<b>20 December 2017</b>	<b>Dr. Kavita Mehra</b> , Publication Advisor attended the 'Launch of the World Inequality Report 2018' organised by Indian Council for Research on International Economic Relations (ICRIER) at India Habitat Centre, New Delhi
<b>22 December 2017</b>	<b>Ms. Meenu Galyan</b> , Research Associate attended a lecture on 'Solar Energy Sector in India' organised by Research and Information System for Developing Countries (RIS) at India Habitat Centre, New Delhi

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home-made filter system using layers of soil and gravel that cleans domestic waste water well enough to make it suitable for irrigation. The filter prototype, tested in Al Haouz, a rural district about 40 km from Marrakech, removed a large amount of waste such as solid particles, organic pollution, and nitrogen and fertiliser residue. The system was also successful at killing off coliform bacteria and other pathogens in the water including faecal matter, E.coli and streptococci bacteria. The cost of this technology is very low compared with systems like lagoon filters, wetlands and sand filters. The filter system consists of a two-stage process that can be easily assembled with local material in water barrels. The researchers created filter 'bricks' from sandy soil, charcoal, sawdust and iron scraps, and packed these into the barrels with gravel. While running through the barrel, the water is filtered alternatively by the bricks and the gravel. The soil bricks on their own were good enough to filter organic waste and nutrients from the water. But when combined with the gravel, the two-stage system became effective enough to tackle pathogens. The system could provide cheap and low-tech water filtration to rural, arid areas. The cost of this technology is very low compared with systems like lagoon filters, wetlands and sand filters. It also has benefits such as simple maintenance, no frequent clogging and no energy requirements. The expected lifetime of each filter system, if correctly maintained, is about 20 years. The method could help recycle water in arid regions, such as the North African and Asian deserts, where water preservation is crucial for farmers and expensive, industrial

water purification is not available. The researchers worked with the people of Talat Merghen village to test the prototypes. They collected domestic waste water from 72 people in eight households. The water was stored in a holding tank, from where it was first fed into a settling tank – to separate sediment and silt – and then into the two-stage filter system. Once optimised for flow load, the system removed around 90 per cent of pollutants, including around 95 per cent of nitrogen, a fertiliser residue. The filtered water was not safe to drink, but was usable for agricultural irrigation and household chores. It could be made potable with additional treatment, such as chlorination or UV light. However, the system would struggle with dangerous chemical pollution, like heavy metals and the more resistant waterborne pathogens such as cholera and salmonella. There is a need for an added disinfection process with chlorine, for example, which adds some disadvantage to the technology. There is also a concern about algae growth in the filter, especially in high temperatures. “The filter media should be backwashed or changed after some time, because any biofilm that forms will cause clogging, which is a problem but the size and surface of the gravel into which the filter bricks are laid could reduce the growth of algae. The prototype might also need further refining to ensure the soil used for the bricks allows enough water to pass. This is important in order to replicate the system elsewhere. Soil hydraulic conductivity can be highly variable and this will impact the ability for the filter to accept and filter sewage for the long-term.

Source: SciDev.Net, 8<sup>th</sup> November 2017

### DISTINGUISHED VISITORS TO THE CENTRE



Dr. Akram Ghadimi, Director, Science Popularization Department, National Research Institute for Science Policy (NRISP), Iran (along with two colleagues)



Prof. Dr. Birol Kilkis, Fellow ASHRAE, Sustainable Energy Systems, Department of Mechanical Engineering, Faculty of Engineering, Baskent University and Associate Prof. Dr. Siir Kilkis, Scientific Programs Expert, Science, Technology and Innovation Policy Department, TÜB TAK, Ankara, Turkey



Dr. A.R. Shivkumar, Senior Scientist, Karnataka State Council for Science and Technology, Indian Institute of Science, Bengaluru, India



Dr. Purnima Sharma, Managing Director and Dr. Vibha Ahuja, Chief G. M., Biotech Consortium India Limited (BCIL), New Delhi, India

## *Past Scientific Associate of NAM S&T Centre*

### **Ms. Subhashree Basu**



Ms. Subhashree Basu joined the NAM S&T Centre on 26<sup>th</sup> September 2013 in the capacity of Research Assistant and continued till 7<sup>th</sup> August 2014. Her primary responsibilities included planning, implementation, evaluation and assessment of various scientific programs of the Centre. She actively contributed towards promotion of scientific activities among students, scientists/academia and scientific organisations in the developing countries through workshops, seminars and training courses and contributed for the S&T Newsletter published quarterly by the Centre. She assisted in the organisation of the International Workshop on 'Sustainable Energy for All: Transforming Commitments to Actions' held at Bengaluru, India during 22-24 February 2014 and the International Workshop on 'Perspectives on Science & Technology Diplomacy for Sustainable

Development in NAM and other Developing Countries' held at Manesar (Haryana), India during 27-30 May 2014. She published a paper titled "Biofuels - An Alternative Energy Source towards A Sustainable and Eco-Friendly Future: The Indian Scenario" in the NAM S&T Centre edited books. Ms. Subhashree has also acquired editorial skills during her affiliation. She contributed in the compilation and further publication of highly valuable books titled 'Contemporary Management Strategies in Intellectual Property Rights relevant to NAM and Other developing Countries', 'Minerals Processing and Beneficiation', 'Selected Topics in Lightning Science and Lightning Protection' and 'Sustainable Energy for All: Transforming Commitments to Action - Lessons Learned and Actions for the Future'. She was also partly responsible for coordinating the work on the implementation of the Centre's Fellowship scheme titled 'Research Training Fellowship for Developing Country Scientists (RTF-DCS) Scheme' for 2013-14 and 2014-15.

Ms. Subhashree is currently working in the position of Associate Program Officer in the Indo-U.S. Science and Technology Forum (IUSSTF), New Delhi which promotes and catalyzes Indo-US collaborations in Science, Technology, Engineering, Research and Innovation through substantive interaction amongst Government, Academia and Industry.

### **Ms. Radhika Tandon**



Ms. Radhika Tandon has worked with the NAM S&T Centre as a Research Associate for about one year and two months. She was actively engaged in the planning, coordination and implementation of multifarious programmes of the NAM S&T Centre, including the organisation of international workshops and training courses, execution of fellowship schemes and publication of scientific books / newsletter as part of the Centre's activities to promote South-South and North-South Cooperation. She has also been involved in drafting of Memorandums of Understanding (MoUs), formulation of technical cooperation agreements and building S&T Partnerships with various countries.

She has contributed to the implementation of the Centre's international fellowship scheme titled 'Research Training Fellowship for Developing Country Scientists (RTF-DCS)'; 'Joint NAM S&T Centre – ZMT Bremen Fellowship Scheme'; 'Joint NAM S&T Centre – ICCBS Fellowship Scheme'; 'Joint CSIR / CFTRI – NAM S&T Centre Fellowship Scheme'; 'Joint NAM S&T Centre – DST (South Africa) Training Fellowship Scheme'; and 'NAM S&T Centre Research Fellowship Scheme'. She has published a paper titled 'Science & Technology Diplomacy in the Area of Nanotechnology', which she earlier presented in the International workshop organised by the NAM S&T Centre jointly with the Department of Science & Technology (DST), Government of India at Manesar (Haryana), India in May 2014, in the Center's publication on "Perspectives on Science & Technology Diplomacy for Sustainable Development in NAM and Other Developing Countries"; and another paper titled "A World driven by Nanotechnology" prepared jointly with Prof. Arun P Kulshreshtha, Director General, NAM S&T Centre for presentation in the NANOSUR Workshop on "Challenges for the Regional and International Cooperation in Nanoscience and Nanotechnology" held at Caracas, Venezuela in October 2014.

Radhika presently works in the Indo-U.S. Science & Technology Forum (IUSSTF) and supports coordination and implementation of scientific programmes. She also actively contributes in programme management and its development. Prior to joining IUSSTF, Radhika worked in the Federation of Indian Chambers of Commerce and Industry (FICCI) and was involved in planning interactive meetings/events and assisting facilitation of policy formulation via interface with the government & business community towards achieving socio-economic goals. Earlier, she also worked in various scientific research organisations as an intern such as the Institute of Nuclear Medicine & Allied Sciences (INMAS) and Naval Material Research Laboratory (NMRL) of the Defence Research and Development Organisation (DRDO), Ministry of Defence; Ranbaxy Laboratories Ltd.; and Central Soil and Material Research Station (CSMRS), Ministry of Water Resources, River Development and Ganga Rejuvenation. She has done Master's degree (M.Tech.) in nanotechnology and has further interest in Science, Technology and Innovation (specifically, nanotechnology) policy framework studies.

## Centre Announces

### International Workshop on TECHNOLOGICAL INNOVATION AND MANAGEMENT FOR SUSTAINABLE DEVELOPMENT (For Greener, Safer & Smarter World)

**Gwalior, Madhya Pradesh, India  
27-29 March 2018**



The 2030 UN Agenda for Sustainable Development with a set of 17 Goals (SDGs) and 169 targets is a plan of action for people, planet and prosperity aimed at, among others, the eradication of poverty, providing a balanced climate, intact ecosystems, universal energy access, doubling the share of renewable energy in the global energy mix, etc. A large number of organisations and individuals across the globe are striving to achieve these. However, it is a long road ahead that

requires a deep understanding of the sociology and science behind the SDG targets, development of technology, innovation and technology management in a multifaceted manner. With this in view, the Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre) announces the organisation of an International Workshop on "Technological Innovation and Management for Sustainable Development (For Greener, Safer & Smarter World)" in Gwalior, India during 27-29 March 2018 in partnership with the ITM University, Gwalior, Madhya Pradesh, India.

The main objectives of the Gwalior Workshop include disseminating knowledge about sustainable development within the framework of the Workshop theme, brainstorming on the current perspectives of sustainable development in developed and developing economies, providing a platform to technocrats, experts and academicians from different countries to present their innovative and constructive ideas, and formulating a holistic approach in decision making on the basis of environment, economies and technology options, which can in follow-up be proposed to respective governments for adoption with necessary amendments.

Scientists, technologists, researchers and academicians desirous of participating in the Workshop may submit their nomination forms electronically directly to the NAM S&T Centre as early as possible, but latest by Monday, 26<sup>th</sup> February 2018.

For further details, please visit the Centre's Website: [www.namstct.org](http://www.namstct.org)

## New Publication



### Science, Technology and Innovation Policies and Strategies Development in Developing Countries

Editor: Prof. Zakaria Fouad Fawaz Hassan Abdalla

ISBN-978-93-5124-902-3

pp. 178 Price Rs. 1295 / US\$70

Science, Technology and Innovation (STI) process has become the basis of development agenda of the nations. The role of STI is well recognised in bringing about the transition of relatively lower end economic performance into high value added activities. In this scenario, the governments and industry professionals as well as those in non-governmental organisations in a large number of developing countries face problems in meeting the challenges from the fast pace of technological

changes, whereas for designing the blueprints and strategic implementation frameworks to provide a planned transformation within countries and organisations, it is absolutely critical to have experts who understand the dynamics of science and technology within the context of economic and market development.

In order to discuss the above issues, the Centre for Science & Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre) in partnership with the International Science, Technology and Innovation Centre for South-South Cooperation (ISTIC), Malaysia under the auspices of the United Nations Education, Science and Cultural Organization (UNESCO) organised an International Training Programme on STI Policy and Management for Developing Countries (ITPS) in Kuala Lumpur, Malaysia on 8-12 August 2016. The main objective of the training programme was to impart necessary knowledge and skills to participants in the development and management of a national STI policy in support of social-economic transformation. This programme brought various stakeholders, viz. scientists, experts and professionals from various countries with emerging economies together to hone up their skills on STI Policy. This book comprises 13 papers from the authors from 12 countries. It is expected to be of great value to the researchers, policy makers and government officials of the developing countries who are engaged in international science and technology cooperation and deal with diplomatic negotiations on S&T affairs.

**Foreword -** Prof. Dr. Manzoor Hussain Soomro, President, ECO Science Foundation, (Pakistan)

**Preface -** Prof. Zakaria Fouad Fawaz Hassan Abdalla, National Research Centre (Egypt)

**Introduction -** Prof. Arun P. Kulshreshtha, Director General, NAM S&T Centre

- 1. Actions of the Science, Technology and Innovation Policy to contribute to the Cuban Economic and Social Development, Maria Esther Cruells Freixas and Nelvin Armando Reyes Rivas (Cuba)**
- 2. Science, Technology and Innovation Development in Egypt, Zakaria Fouad Fawzy Hassan (Egypt)**
- 3. Science, Technology and Innovation Development in Indonesia, Ary Syahriar, Hidayat Yorianda and Ahmad Husin Lubis (Indonesia)**
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- 11. Present Status and Highlights of Science, Technology and Innovation Policy in Suriname, Usha P. Adhin (Suriname)**
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- 13. The Present Status and Highlights of the STI Policy in Uganda: Plans and Priorities, Collins Tumusiime (Uganda)**

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